EIKER

Standardization of the
Talbot-Jones Brick Rattler

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# STANDARDIZATION

OF THE

# TALBOT-JONES BRICK RATTLER

BY

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## THESIS

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This is to certify that the thesis prepared under the immediate direction of Instructor L. G. Parker by

WILLIAM HENRY EIKER

entitled CALIBRATION OF THE TALBOT-JONES RATTLER

is approved by me as fulfilling this part of the requirements for the Degree of Bachelor of Science in Civil Engineering.

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# Standardization of the Talbot-Jones Brick Rattler.

## Introduction.

The most widely used material for paving in the inland cities of this country is vitrified brick or paving block. With this extensive use has arisen the desirability of finding a standard method of testing the brick.

Requirements of a Standard Test.— Any test to be of value and to be used as a standard should be acceptable to both the manufacturers and the users of the brick, and should have the following important requirements:

(1.) The two forces to which the bricks are mostly subjected when placed in the pavement are those of impact and abrasion. We should therefore have the proper amount of impact and abrasive forces in the test, and as near as possible the proper relation between these two should be obtained.

(2.) The grading of brick is an important

item, and it is desirable to obtain a test which will show a clear and certain distinction between different grades of brick. For example, curves plotted from tests showing the percentage of loss for hard, medium and soft specimens, should show a marked distinction between each other. The grading power of the test is thus increased.

(3.) Uniformity of the brick is a desirable quality, so the test should give a good opportunity to test individual brick to see to what extent this quality is present in any particular burn or brand.

(4.) To avoid cost of construction and operation the mechanism should be simple and the test should require as short a time as possible and still give valuable results.

(5.) Variations from standard conditions should be small.

<u>Tests</u> <u>Used</u>.— Many tests have been used from time to time, the following being the principal ones; (a) the Crushing Test, (b) the Transverse Test; (c) Absorption

Test, (d) the Specific Gravity Test, and (e) the Impact and Abrasion Test. None of these tests is as ideal as desired, but the one most generally used and which gives the best results is the Impact and Abrasion Test. In this method the important requirements for a standard test are more nearly fulfilled than in any other. For making this test a machine known as the brick rattler is used. Formerly any ordinary foundry rattler was employed but no definite charge, speed, or number of revolutions were required. Each city and brick manufacturer had their own size of rattler, charge, speed and number of revolutions. Mr. J. H. Burt, in the Technograph for 1896, reported that specifications for these tests from fifteen cities showed the following range of values: Length of rattler 24 to 54 inches; diameter 15 to 40 inches; revolutions per minute 15 to 55; duration 30 to 360 minutes; weight of iron 50 to 800 pounds; loss permissible in one hour 3 to 20 per cent.

These variations were very unsatisfactory, especially to the manufacturers, and after an elaborate study of the problem by the National Brick Manufacturers Association, through a commission of engineers and brick makers, the rattler test was adopted by the Association as the principal test. The rattler adopted by them is known as the N. B. M. A. Standard Rattler, a detailed description of which may be obtained from the specifications adopted by this Association and known as the N. B. M. A. Standard Test for Paving Brick.

General Description of Standard Rattler.

The machine adopted by the National Brick Manufacturers Association consists of a fourteen sided cylinder 20 inches long and 28 inches in diameter. In this cylinder the brick to be tested and a charge of shot of specified size and proportion are placed and the whole rotated at a prescribed speed for a specified time. The brick are weighed before and after the test and the percentage of loss calculated.

From these results the quality of the brick is determined.

While this test has not given entire satisfaction, it has been found more satisfactory than any other and is still recognized as the standard test by both the manufacturers and the users of paving brick. The greatest defect claimed against this method of testing and one that is considered serious, is that the test does not sufficiently distinguish between various grades of brick. Other objections are that the conditions of the test are not similar to those of the brick in the pavement, and it is difficult if not impossible to test individual brick.

## Development of the Talbot-Jones Rattler.

Numerous tests were conducted by different experimenters on various forms of new rattlers, with the end in view of correcting the faults of the standard rattler.

In 1899 Mr. Gomer Jones, of Geneva, N. Y. devised a rattler in which the brick to be tested were clamped in pockets around the circumference of a cylinder

instead of being rattled loose with the shot. This was a nearer approach to actual conditions under which the brick are used. Tests conducted by Prof. Edwin Orton Jr. with this machine showed that it had many defects. The greatest defect being that the spaces between the brick were too great.

In 1900 Prof. A. N. Talbot, of the University of Illinois, devised a machine which is a modification of Mr Jones' rattler and is known as the Talbot-Jones Brick Rattler. In this rattler the brick are clamped around a circumference forming a brick cylinder which receives the impact and abrasive forces produced by the falling and rolling shot. At a meeting of the National Brick Makers Association, a committee was appointed to investigate this machine and to report upon its merits for the testing of paving brick. This committee recognized the advantages of the new machine but recommended that the standard be not changed.

As the work of this thesis is concerned

with this rattler a detailed description of it will be given.

Plate I shows the details of this rattler.

## Description of the Talbot-Jones Rattler.

The Talbot-Jones Rattler consists of a thin drum 37 inches in interior diameter, fastened to a cast iron head. Between the drum and the head is a $\frac{3}{8}$ inch space to allow the dust and small pieces of brick to escape. Near the outer circumference of the head, is a groove $\frac{5}{8}$ of an inch wide running entirely around the rattler head. Into this groove are placed the bolts used for fastening the brick in position. This groove is accessible through holes $1\frac{1}{8}$ inch in diameter. The groove is $1\frac{5}{8}$ inch from the inside of the drum, thus allowing room for the wooden spacers used between each brick. The inside edges of the brick, when placed in position in the rattler, fit against the head for a distance of $3\frac{3}{8}$ inches, the upper portion of them being left free to allow for wear. This is accomplished by setting the head back about $\frac{3}{4}$ of an inch at this point.

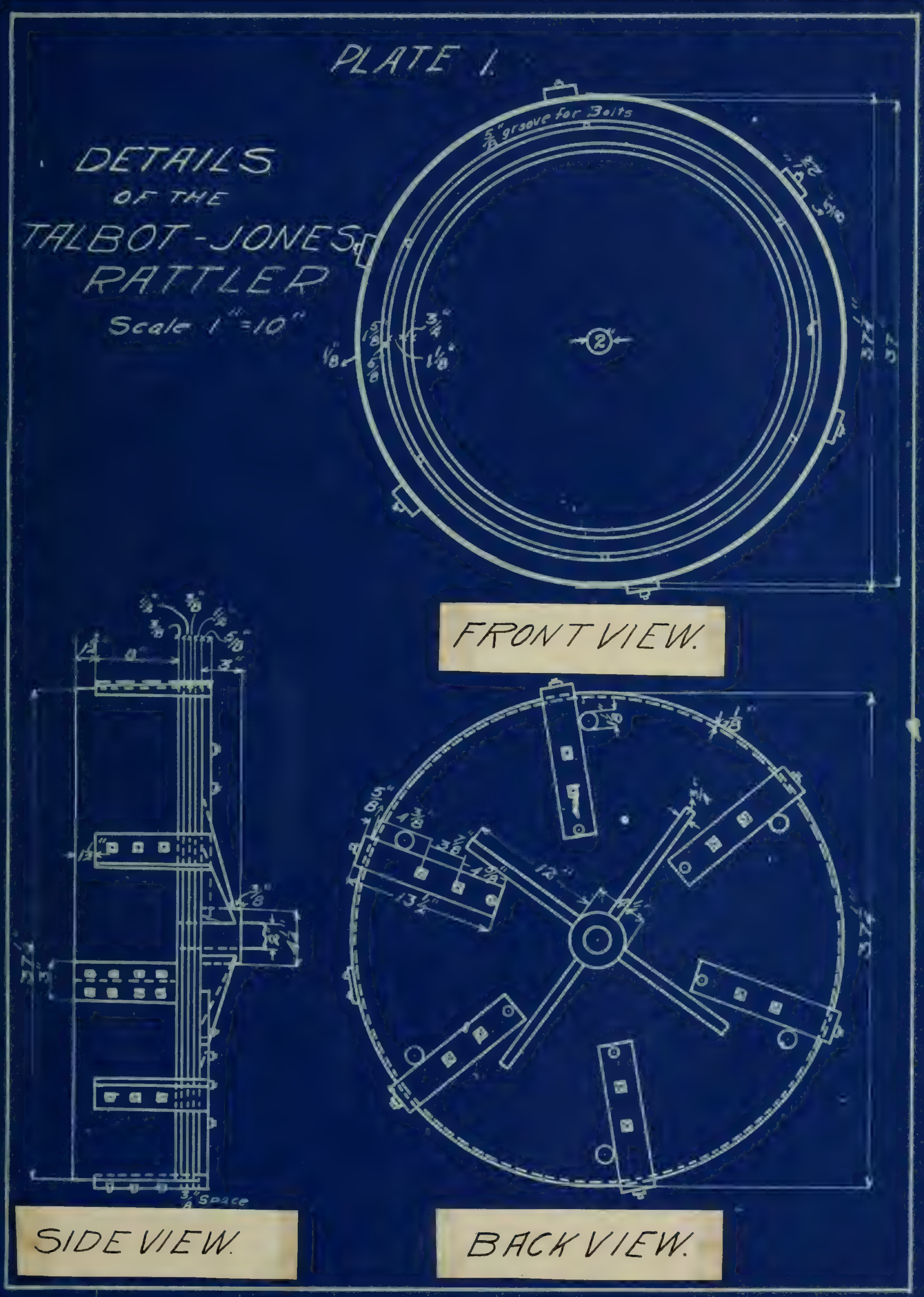
PLATE I.
DETAILS
OF THE
TALBOT-JONES
RATTLER
Scale 1" = 10"
5/8" groove for Bolts
FRONT VIEW.
SIDE VIEW.
BACK VIEW.
3/8" Space

A spacer and a bolt are placed between adjacent bricks and the outer end of the brick held in position by rectangular washers. A wooden end or head is placed over the open end of the rattler. This head is 33 inches in diameter and $1\frac{1}{4}$ inches thick. It has a hole about 11 inches square in it to allow the charge of shot to be placed in the machine. To prevent any shot from being thrown out through this hole, it is closed by a wooden cover. This head is held some distance from the ends of the brick by the washers and the nuts on the bolts, thus making the ends of the brick about the same distance from the two heads of the rattler. The rattler is of the over hanging type.

Method of Testing.— Many experiments have been conducted with this machine within the last few years from which much valuable information concerning the operation and action of the machine can be obtained. Persons desiring such information are refered to the following theses: "Comparison of the Talbot-Jones and the

N. B. M. A "Standard Rattler Tests of Paving Brick", by Mr C. W. Malcom, 1902; "Tests of Paving Brick from Street Pavements", by Mr. E. W. Block, 1903; "Calibration of the Talbot-Jones Brick Testing Machine", by Messrs. Righter and Habermeyer, 1903. These experimenters have used various values for the weight of shot, spacing of the brick, speed and number of revolutions. In the following description the values are those determined by Righter and Habermeyer as giving the best results.

Enough brick to fill the circumference of the machine and make the spaces between the brick approximately $\frac{1}{4}$ of an inch are placed in the rattler by means described on page 7. The charge of shot consists of 75 pounds of cast iron cubes, 60% or 45 pounds being $1\frac{1}{2}$ inch cubes and 40% or 30 pounds being $2\frac{3}{8}$ inch cubes. The rattler is run at a speed of 36 revolutions per minute for 6000 revolutions. Instead of the wooden head originally used to close the open end of the rattler, Messrs. Righter and Habermeyer designed a head consisting of heavy iron screen.

this screen is better than the wooden head for it allows the dust and chips to escape from the rattler more readily and for experimental work is especially good as the behavior of the shot can easily be observed.
The brick are weighed before and after the test and the percentage of loss calculated.

## Advantages of the Talbot-Jones Rattler.

It is claimed that the requirements for a standard test, mentioned on Page 1. are more nearly fulfilled by this machine than by any other and that it corrects the objections made against the N. B. M. A. Standard Rattler.
The advantages of the Talbot-Jones Rattler over the Standard Rattler are as follows:

Conditions of Test. – The brick are placed in this machine in a position very similar to that which they have when in the pavement and the wear on the brick is very much like that produced by street traffic.

Opportunity to Test Individual Brick. – Each brick being clamped in position

offers a good opportunity for testing individual brick.

Grading Power. — The greatest advantage of this machine is its grading power. Lack of this power in the Standard Rattler has been mentioned as the greatest objection to that machine. Mr Malcom shows in his experiments that the distinction between different grades of brick is much greater for the Talbot-Jones than for the Standard Rattler. He obtained the following values: for Clinton Block the ratios of the losses of medium, soft and hard brick are as 1:2.1:3.9 respectively for the Talbot-Jones Rattler and as 1:1.17:1.21 respectively for the Standard Rattler.
Mr Block found the ratios of wear between the poorest and the best brick to be as 10.56:2.67 respectively or as 4:1 with the Talbot-Jones Rattler and as 24.16:10.69 respectively, or as 2.3:1 with the Standard Rattler. These values show the better grading power of the Talbot-Jones Rattler.

## Disadvantages of the Talbot-Jones Rattler.

Time Required for a Test.– A disadvantage of the Talbot-Jones Rattler which, although not serious, has perhaps been a factor in preventing its more general use, is the time required to make a test. Mr. Malcom gives a detailed comparison of the time required for a test with the Talbot-Jones and with the Standard Rattler. His values follow; Talbot-Jones Rattler; "time to place brick in position in the rattler 60 minutes; time to put on and remove cover, to put in and remove charge of shot and to remove the brick about 30 minutes, time of rattling 70 minutes; total 2 hours and 40 minutes.

Standard Rattler: the minimum time of test with this machine is 1 hour for rattling and ten minutes to put in and remove charge or a total of 1 hour and 10 minutes.

Using the values recommended by Messrs Rightor and Stahrmeyer increases the time of test with the Talbot-Jones Rattler

to 4 hours and 15 minutes.
Such a decided difference as this in the time required for a test must be a factor against the Talbot Jones Rattler unless the results obtained with this machine are such as to justify the longer test.

Unequal Fall of Abrading Material.- A serious disadvantage of this machine is that the abrading material is carried to different heights depending upon the width of the spaces between the bricks and the condition of the brick surfaces. A wide spacing and a rough surface carries the material higher than does a narrow spacing and a smooth surface. The spacing is not always uniform in a test for when the last few brick are placed in position it may be necessary to increase or diminish the spaces in order to fill the cylinder. Variation in the sizes of brick give various spacing in different tests.
These conditions are responsible for the variations in the results obtained

by different experimenters for each used the charge, spacing, speed and number of revolutions which in his case appeared to give the best results.

The intensity of the impact is affected by the height to which the abrading material is carried and consequently the test is not uniform for different kinds of brick.

The advantages of the Talbot-Jones Rattler over the Standard Rattler are such that if the objectionable features can be corrected there is reason to believe that this machine might be adopted as a standard.

It was believed that the more serious disadvantage above mentioned could be eliminated by constructing a machine in which the edges of the brick could be brought closer together and modifying it to permit of filling the circumference with an integral number of brick with an even spacing and then introducing a baffle of some kind

to prevent the abrading material from being carried beyond a certain height on the circumference.

With this end in view Prof. Talbot designed a modification of his old rattler. This new machine was constructed and is set up in the Road Materials Testing Laboratory of the University of Illinois where the experiments of this thesis were conducted.

The object of these experiments was to determine the practicability of these changes in the machine as a means of standardizing the Talbot-Jones Rattler and if they were found to be practicable, to determine values for charge, speed, spacing and number of revolutions which should be adopted as a standard.

## The New Machine.

Plate II shows an end elevation of this machine.

The new machine differs from the old one in that the cylinder which carries the charge of brick is adjustable and can be removed from the stationary

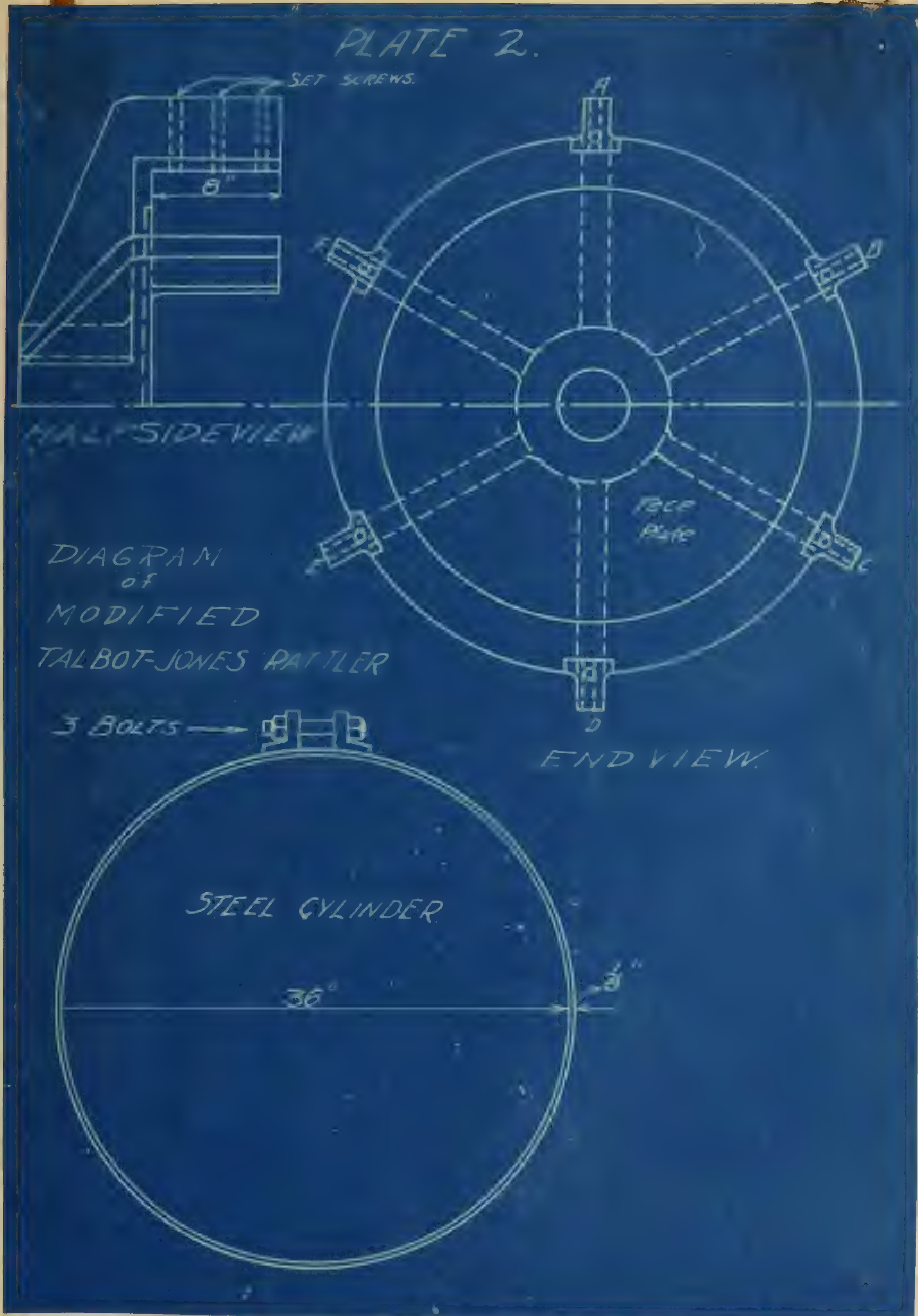
PLATE 2.
SET SCREWS.
8"
HALF SIDE VIEW
A
B
C
D
E
F
Face Plate
END VIEW.
DIAGRAM of MODIFIED TALBOT-JONES RATTLER
3 BOLTS
STEEL CYLINDER
36"

face plate. This cylinder is held in place against the face plate by set screws through the lugs, A, B, C, D, etc. and by clamps over the bolts in the end of each lug. These clamps also hold the screw head in place.

To charge the machine the circumference of the cylinder is made as large as possible and placed edgewise upon the floor or any flat surface. The brick to be tested are then placed in the cylinder as shown in Figure 1.

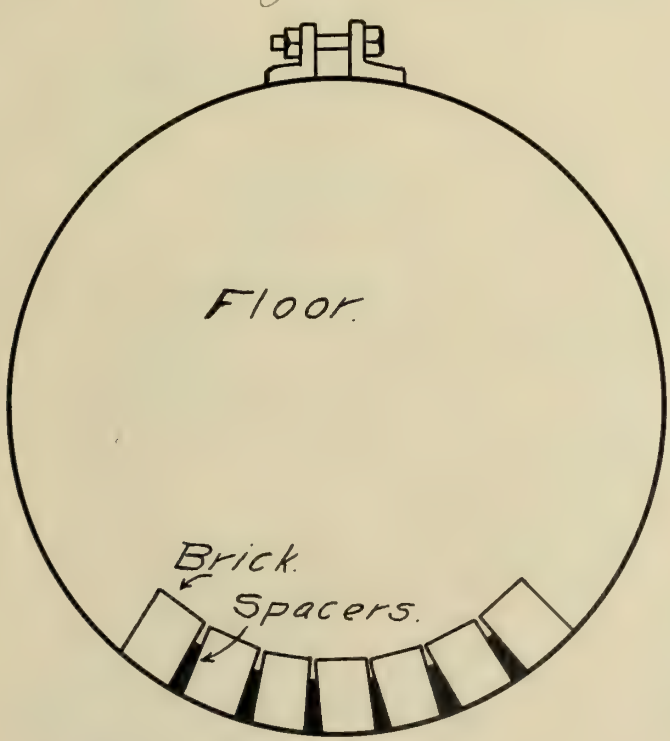


FIGURE 1.

Between the brick, wedge shaped wooden spacers are placed to furnish a bearing surface and to prevent the edges of the brick from touching when the cylinder is tightened. Various sizes of spacers should be used to provide for variations in the size and shape of the brick. The sizes shown in Figure 2 have been used.

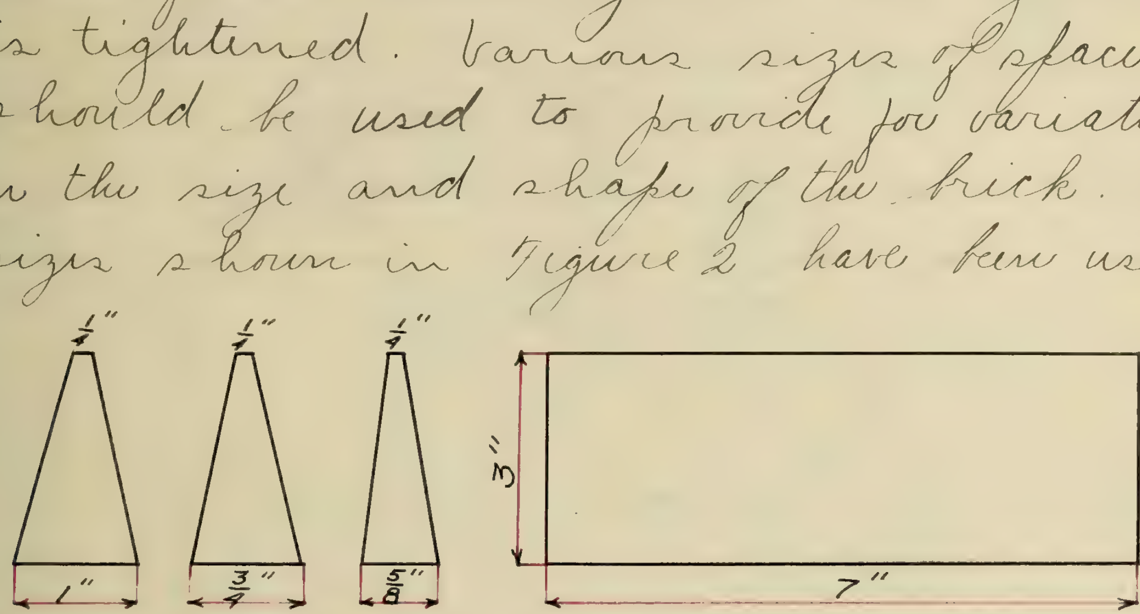


Figure 2.

When as many brick as can be contained in the cylinder are in place, the bolts are screwed as tightly as possible and the cylinder is lifted into place against the vertical face plate of the machine, resting on the adjustable plates of the lugs. The heads of the bolts which adjust the cylinder should be in contact with one of the lugs to prevent the cylinder from creeping when the machine is revolved.

The cylinder is adjusted to a perfect circle by tightening the set screws

through the lugs. A strip of wood of the desired radius which revolves upon a pin set in the center of the face plate, furnishes a gage for this adjustment.

The adjustable cylinder permits a uniform spacing and the use of an equal number of brick for every test.

## Experiments.

The new machine was first used by Mr. H. P. Greenwood in thesis work for 1905. He found that with the space between the brick reduced to a minimum, the friction of the shot on the brick was sufficient to carry it above the center of the cylinder but in attempting to use a baffle plate it was so quickly bent that no results were obtained. He placed his baffle plate in a horizontal position in the center of the cylinder. According to his report the force of the shot was so great that the plate was bent through an angle of about 90 degrees before any results were obtained with it.

The writer thought that if the plate could be placed in the machine in a

position where the forces would not be so great it might withstand these forces and results be obtained which would show the effect of such a plate being placed in the rattler.

Instead then of having the plate in a fixed position it was arranged so as to be placed in the machine at any desired angle. This was accomplished by fastening one end of the axle to a pivoted arm which was bolted to a heavy wooden horse placed outside of the machine.

Experiment I — Experiment I was run without a baffle plate for the purpose of observing the behavior of the shot in the rattler and to secure data for a comparison of the results with and without the baffle plate.

The cylinder was filled with 26 brick by the method described on page 16. The brick were placed as close as possible without touching. The abrading material consisted of 75 pounds of cast iron cubes, 45 pounds being $1\frac{1}{2}$ inch cubes and 30 pounds being $2\frac{3}{8}$ inch cubes. The sharp

edges and corners of the cubes were rounded off before using. The rattler was run at 36 R.P.M. for 6000 revolutions. The wire screen head was used.

It was found to be impossible to adjust the cylinder to a perfect circle. The thickness of $\frac{1}{8}$ of an inch for the cylinder is not sufficient to prevent its bulging between lugs when the set screws are tightened.

Careful observation during the test showed the following facts:

(1.) The impact force of the test is furnished by the shot being carried up the side of the cylinder to a height about $\frac{2}{3}$ of the diameter and then falling diagonally across the machine striking the brick on the opposite side.

(2) Excessive impact force is caused by a tendency of the shot to bunch up and fall in a heap. This action is noticeable throughout the test by heavy thuds which occur at frequent intervals. Several blows occur in succession before the bunch of shot is broken and the ordinary falling resumed.

(3.) The abrasive force is furnished by the shot rolling and sliding over the brick. The shot which do not rise high enough to fall across a diameter furnish this force.

(4) The friction is sufficient to carry a few shot around the entire circumference without falling.

(5.) The wear on the brick due to chipping is greatest in the early part of the test.

The numerical results of Experiment I are given in Table I on page 22.

Experiment II.— In Experiment II the use of a baffle plate was attempted. It was decided to place the plate in a position to intercept the shot near the point where the majority of them started to fall because the force against the plate would be less here than in the horizontal position. Accordingly, from the observations of Experiment I, a plate was placed in the rattler at an angle of about 60 degrees with the horizontal.

Figure 3 gives the dimensions of this plate and shows its position in the rattler.

# TABLE I.

## RESULTS OF EXPERIMENT I.

| Ref. No. | Wt. of Br'k in Kilograms | | Kilogr'ms Lost. |
|---|---|---|---|
| | Before. | After. | |
| 1. | 4130 | 3460 | 670 |
| 2 | 3990 | 3650 | 340 |
| 3 | 4190 | 3780 | 410 |
| 4 | 4010 | 3550 | 460 |
| 5 | 4020 | 3670 | 350 |
| 6 | 4015 | 3720 | 295 |
| 7 | 4110 | 3850 | 260 |
| 8 | 4150 | 3810 | 340 |
| 9 | 4015 | 3800 | 215 |
| 10 | 4060 | 3670 | 390 |
| 11 | 4150 | 3700 | 450 |
| 12 | 4050 | 3720 | 330 |
| 13 | 4070 | 3580 | 490 |
| 14 | 4150 | 3770 | 380 |
| 15 | 3930 | 3660 | 270 |
| 16 | 4100 | 3850 | 250 |
| 17 | 4070 | 3800 | 270 |
| 18 | 3990 | 3460 | 530 |
| 19 | 4040 | 3760 | 280 |
| 20 | 3960 | 3570 | 390 |
| 21 | 4020 | 3670 | 350 |
| 22 | 4020 | 3670 | 350 |
| 23 | 4270 | 3950 | 320 |
| 24 | 4090 | 3710 | 380 |
| 25 | 3980 | 3690 | 290 |
| 26 | 4140 | 3680 | 460 |
| Total | 105720 | 96275 | 9445. |

Loss in % of Total Weight = 8.9

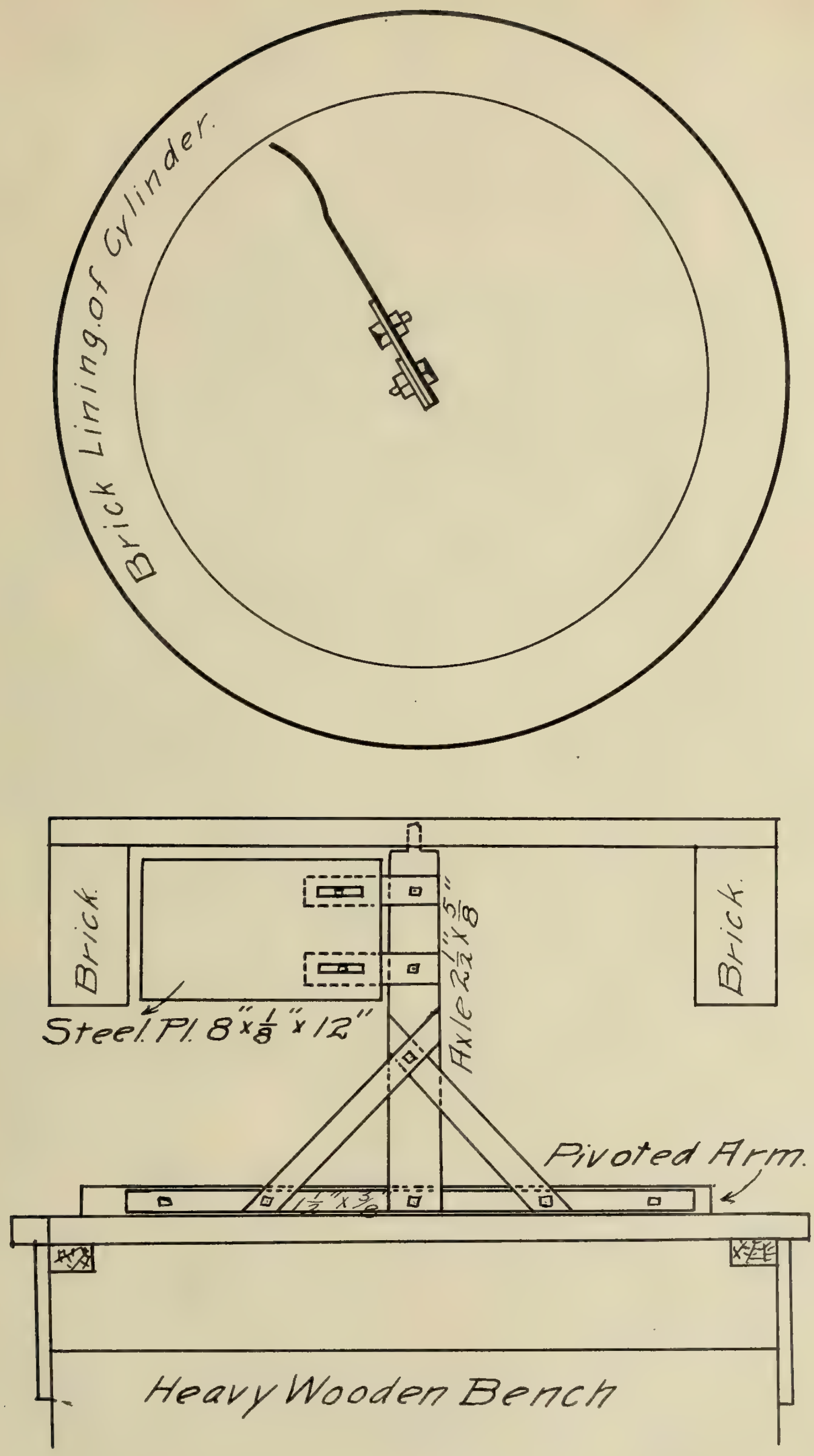
Brick Lining of Cylinder.
Brick.
Brick.
Axle 2½" x ⅝"
Steel Pl. 8" x ⅛" x 12"
Pivoted Arm.
1½" x ⅝"
Heavy Wooden Bench

FIGURE 3.

The end of the plate was placed as near the surface of the brick as possible. Owing to the bulging of the cylinder between lugs this distance varied from $\frac{1}{4}$ of an inch to $1\frac{1}{2}$ inches.

Values for speed, etc. were the same as those used in Experiment I.

Only about ten revolutions were made by the machine before the plate was rendered useless so no numerical results were obtained in this test. It was observed however that the bending of the plate was caused by shot lodging between the end of the plate and the brick. This trouble could probably be overcome by making the adjustable cylinder heavier or by providing more lugs on the machine so as to permit adjustment to a perfect circle.

The plate did not hold long enough to show what effect the impact of the shot would have on it.

The only fact developed by Experiment II is that bending of the plate may occur from other causes than impact alone of the shot against it.

The result of Experiment II is shown by the photograph below.

Experiment III. – Failing to secure any results from Experiment II, a new plate of heavier construction was made and Experiment III performed with the plate in a vertical position. The plate was placed in a vertical position in order to reduce the danger of shot lodging between the end of the plate and the brick.

The thickness of the plate was increased to $\frac{1}{4}$ of an inch and a small angle was riveted on the back for reinforcement. The plate is shown in the photograph below.

The charge, speed, etc. were the same for this test as for Experiment I.

In this test about 1000 revolutions were obtained before the plate finally failed and several valuable facts concerning the effect of such a plate in the rattler were observed.

The writer paid the closest possible attention to the behavior of the shot

during the entire test and the change in conditions from those observed in Experiment I were very evident.

(1) The greatest and most important change noticed was the difference in the percentage of wear on the brick produced in the two tests. This is occasioned by the deflection of the shot by the plate. In Experiment I the shot were described as rising to a height of about $\frac{2}{3}$ of the diameter then falling diagonally across the machine, striking the surface of the brick and causing wear by impact. When intercepted by the plate these shot instead of being thrown to the bare surface of the brick fell back on the ascending shot.

Previous experience with the rattler tests made it necessary to enclose the machine in a dust proof box to prevent the dust from the test filling the entire building in which the rattler was located. At no time during Experiment I could the observer enter this box because of dust and flying chips while in Experiment III he was in the box during the

entire test. This is good evidence of the small amount of wear produced on the brick in Experiment III. Practically all the wear in this test was caused by the rolling and sliding shot thus giving an abrasive test rather than an impact test.

These results indicate that the present test with the Talbot-Jones Rattler is decidedly an impact test.

(2.) A desirable result obtained by using the plate is the increased regularity of the falling shot. The terrible pounding caused by the shot bunching up and falling in a heap was entirely corrected in this experiment. When bunching did occur it was immediately broken up by the plate so that the fall was very regular throughout the entire test.

(3) The bending of the plate was very gradual in this test and was evidently caused by the shot striking against it. Close observation showed that the plate was not bent by the wedging of shot between it and the brick. The regular striking of the shot had no apparent effect and the bending was caused by the heavy

masses of shot striking the plate.
The bunching of the shot is mentioned in tests with the old rattler so it is not a defect of the new machine alone.
Numerical results of Experiment III are given in Table II on page 30.
The brick used in all these tests were Western Pavers and were all selected to be as nearly of the same grade as possible.

## Conclusions.

From the results of Experiment III and the consideration of other plates the writer concludes that the standardization of the Talbot-Jones Brick Rattler by the use of a baffle plate in the machine is entirely impracticable.
There are two reasons for this conclusion.
(1.) The forces to which the plate is subjected are so great that a very heavy construction will be required and the overhanging type of machine makes it difficult to place a plate in a position to resist these forces. In Experiment III the forces were so great that the heavy wooden horse, weighted with about 300

# TABLE II.

## RESULTS OF EXPERIMENT III.

| Ref. No. | Wt. of Br'k in Kilograms Before | After | Kilograms Lost. |
|---|---|---|---|
| 1. | 4100 | 4080 | 20. |
| 2 | 4040 | 4030 | 10. |
| 3 | 3980 | 3980 | 00. |
| 4 | 4090 | 4080 | 10. |
| 5 | 4100 | 4100 | 00. |
| 6 | 4020 | 3990 | 30. |
| 7 | 4020 | 4020 | 00. |
| 8 | 3970 | 3970 | 00. |
| 9 | 4100 | 4100 | 00. |
| 10 | 4010 | 3990 | 20. |
| 11 | 4110 | 4060 | 50. |
| 12 | 4100 | 4080 | 20. |
| 13 | 4100 | 4100 | 00. |
| 14 | 4060 | 4060 | 00. |
| 15 | 4160 | 4120 | 40. |
| 16 | 4050 | 4050 | 00. |
| 17 | 4120 | 4100 | 20 |
| 18 | 4050 | 4010 | 40. |
| 19 | 4010 | 4000 | 10. |
| 20 | 4000 | 3950 | 50. |
| 21 | 4020 | 4020 | 00. |
| 22 | 4020 | 4020 | 00. |
| 23 | 4010 | 3970 | 40. |
| 24 | 4110 | 4100 | 10. |
| 25 | 3970 | 3970 | 00. |
| 26 | 4050 | 4010 | 40. |
| Total | 105470 | 105060 | 410 |

Loss in % of Total Weight = 0.39

pounds of brick, to which one end of the axle was attached was with difficulty kept in place and the $2\frac{1}{2}" \times \frac{5}{8}"$ axle was twisted entirely out of shape.

(2.) The change in the condition of the test is such as to make the use of the plate impracticable. In Experiment III the rattler was run for 1000 revolutions and the wear on the brick was practically inappreciable. With this rate of wear on the brick the test would have to be continued for so long a time as to make it entirely impracticable.

Other positions for the plate have been suggested but after considering them carefully the author is of the opinion that none of them would give satisfaction. If the shot are stopped at a certain height, which is the desired purpose of the plate, the force which is now directed against the brick will be lost against the plate. Any plate which does not fix the height to which the abrading material rises is not accomplishing its purpose.

One position suggested for the plate is

that shown in Figure 4.

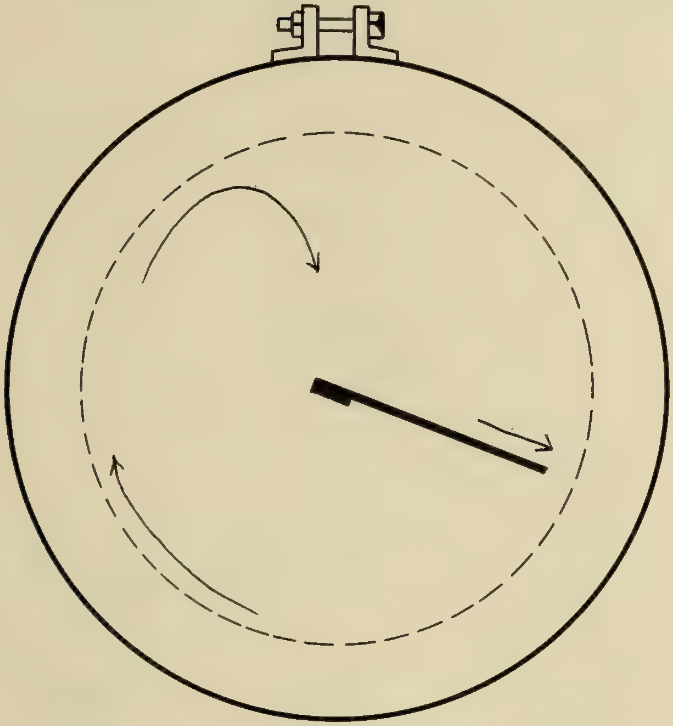

FIGURE 4.

This position for a baffle plate is objectionable for two reasons.

(1.) The height to which the shot is carried on the circumference is not regulated consequently the force with which the shot are deflected from the plate will vary in different tests.

(2.) When the plate is placed in this position to intercept the falling shot the result will be the same as that noted in Experiment III; most of the force of the shot is lost on the plate instead

of causing wear on the brick. Any plate set in a radial position will have this defect.

Another position suggested for a plate is that shown in Figure 5.

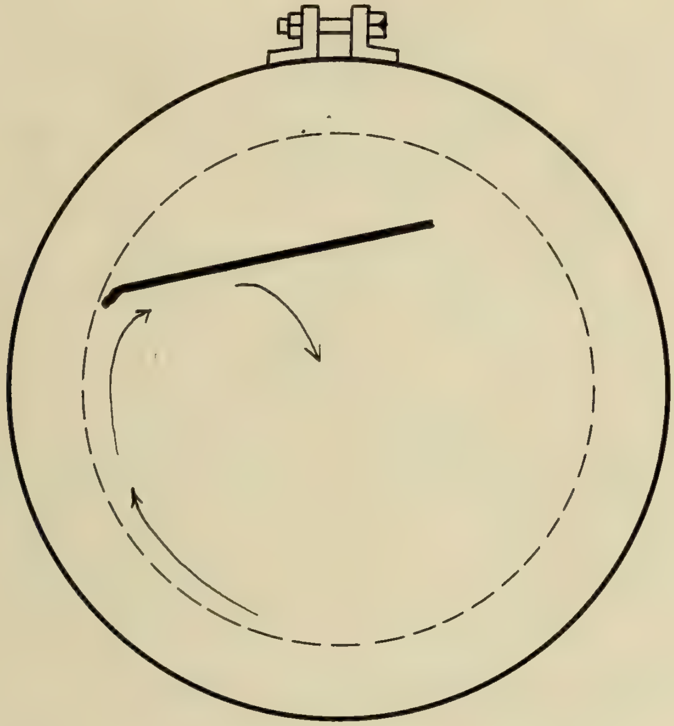

FIGURE 5.

The defects of the plate shown in Figure 3 would be somewhat corrected by the plate of Figure 5 but it is doubtful whether a plate could be placed in this position which would withstand the force of the shot. The tendency of the shot to lodge between the end of the plate and the brick would be great with

the plate in this position and because of the inability to adjust the cylinder to a perfect circle it was thought useless to attempt the use of this plate in these experiments.

In conclusion the writer recommends the use of the adjustable cylinder as an improvement over the original Talbot-Jones Rattler. The uniform spacing thus obtained corrects somewhat the unequal fall of the shot in different tests.

The cylinder should be made ¼ of an inch thick and more lugs should be placed on the machine.

The charge should consist of 26 brick spaced ¼ of an inch at their inner surface and the other conditions for the test should be those stated on page 9.